CEREALS CANADA

National Wheat Research Priorities 2023-2028

In partnership with

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

CEREALS CANADA

Cereals Canada is the national, not-for-profit, industry association representing the Canadian cereal grains value chain. We value relationships and work with government and stakeholders to provide timely, expert technical information and deliver best-in-class customer experience. We are dedicated to supporting the Canadian cereals value chain including farmers, exporters, developers, processors, and our customers around the world with a focus on trade, science, and sustainability.

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Agriculture and Agri-Food Canada supports the Canadian agriculture and agri-food sector through initiatives that promote innovation and competitiveness. The activities of the Department range from the farmer to the consumer, from the farm to global markets, through all phases of producing, processing, and marketing of farm, food, and bio-based products. Agriculture is also a shared jurisdiction in Canada, and the Department works closely with provincial and territorial governments in the development and delivery of policies and programs.

Building National Research Priorities for Wheat

The National Wheat Research Priorities were created to guide research in the Canadian wheat industry for the next five years through a shared set of goals that recognize regional differences. Funders can contribute to research programs that address national goals, but at the same time invest in specific, localized priorities as well. Through this shared set of goals, industry and the research community will come together through focused activities, such as workshops and symposia, where knowledge is shared, networks are built, and synergies are developed.

History

In 2016/17, the Grains Roundtable, co-chaired by Cereals Canada and AAFC (Agriculture and Agri Food Canada), facilitated the development of national, five-year plan—Canadian Wheat Research Priorities: 2017-2022 Outlook—to serve as a vision for wheat research and provide guidelines to help co-ordinate research efforts for wheat productivity and competitiveness. An interim update was completed in 2020.

In 2022, the process to update the national wheat research priorities for the next five years included a series of virtual meetings with six theme working groups from April to June 2022. Working group members included a cross section of stakeholders including public and private researchers, extension specialists, producer organizations, grain buyers/exporters and other stakeholders. This effort also extended the reach of the third set of priorities to consumer needs, by the addition of a sixth theme regarding wheat nutrition. This report is a combined summary of the discussion and recommendations of each theme group. This initiative updates the National Wheat Research Priorities for 2023-2028 to serve as a vision and guide for wheat research over the next five years.

Key Measures

The six research themes are interconnected and it is not always possible to develop specific, meaningful measurements to track research progress for individual goals and outcomes. Instead, overarching measures have been developed to identify trends in the Canadian wheat industry and farm profitability, and serve as a broad reflection of our progress in wheat research, cultivar development, and knowledge transfer.

Measuring Success

All six research themes share these measures of success:

Measure 1 > Wheat Yield Increase

Measure 2 > Wheat Production Trends

Measure 3 > Uptake of Best Management Practices

Measure 4 > Benchmarking Canadian Wheat

Knowledge Transfer

Each of the six National Wheat Research Priorities themes comes with a strategic commitment to openly communicate with the Canadian wheat value chain and stakeholders, and the global wheat research community, ensuring information provided is reliable and consistent across all platforms.

We are committed to developing a coordinated and collaborative Canadian system to proactively monitor and communicate global regulatory changes and food safety challenges, and to disseminate wheat nutrition research results to Canadians, dietitians, health professionals and health communicators through the What About Wheat? campaign.

National Wheat Research Priorities 2023-2028

Theme 1

Improving Wheat Yield

- Yield potential maximized
- The efficiency of R&D and wheat breeding processes are maximized

Theme 2

Crop Environment Interactions

- Yield stability under a variable climate
- Management of insect pests
- Management of wheat diseases
- Management of weeds

Theme 3

Cropping System Sustainability

- Sustainable wheat rotations
- Maximize efficiency of input use
- Improved decision-making tools for the farm that benefit wheat crop sustainability

Theme 4

Continuous Improvement in Food Safety

- Continue to manage risk related to the prevalence of mycotoxins, heavy metals, and pesticide residues to meet compliance with global standards
- Continue to foster a robust food safety system to identify and manage new food safety issues

Theme 5

Customer Quality

- Market opportunities for Canadian wheat are increased
- Wheat quality and consistency are maintained and meet customer needs

Theme 6

Wheat Nutrition

- Wheat and wheat products are recognized as nutritious components of healthy diets
- Wheat production and processing provides enhanced nutrition and value-added products

Canada is a world leader in the production of safe, high-quality, and nutritious wheat and wheat products

Wheat Production

Wheat production in Canada has a gross export value of 9 billion CAD, annually. Grown on 9.8 million hectares (24 million acres) which can produce an average of 32 million tonnes (2016-2020), it is Canada's largest acreage field crop.[1] Canada's domestic market needs 8-10 million tonnes of wheat for food (milled into flour), animal feed and industrial uses (i.e. ethanol production)[2] and creates billions in value added activity for our country. Our ability to produce more food than is required domestically makes Canada a major exporter, providing between 20-24 million tonnes of wheat to more than 70 countries every year.

[1] Statistics Canada and AAFC: Area, Production and Yield of Canadian Principal Field Crops
[2] Statistics Canada and AAFC: Canada Field Crops - Historical Supply and Disposition

National Wheat Research Priorities 2023-2028

Theme 1
Improving Wheat Yield

Canadian farmers need strong wheat yields to be sustainable. Research and innovation play a critical role in improving wheat yield. This can be accomplished through:

- strengthening the capacity in Canada for field-ready cultivar development.
- increasing yield stability through establishment of adaptation testing and evaluation networks across regions.
- implementing tools to efficiently incorporate traits of interest.
- utilizing effective new technologies and tools at appropriate stages of research and development.

> "With an increasing world population, expected to be more than 9 billion by 2050, world wheat demand is predicted to increase to 900 million tonnes, exceeding current production levels of around 725 million tonnes."

Outcome 1:

Maximize yield potential and increase yield stability of Canadian wheat cultivars.

Key Targets:

- Increase funding for field-ready cultivar development, supported by germplasm development and upstream technologies (e.g., genomics, digital phenotyping).
- Improve yield stability through establishment for adaptation testing and evaluation networks across regions.
- Optimize sustainability of wheat production by maximizing yield in coordination with input use efficiency.

Outcome 2:

Maximize the efficiency of R&D and wheat breeding processes by implementing effective tools and resources.

Key Targets:

- Maintain and expand capacity for critical trait screening and selection including disease resistance screening.
- Implement prediction models for genomic selection.
- Develop and apply technologies to identify new traits, increase breeding efficiency and increase crop input use efficiency (e.g., genomics, high-throughput phenomics, data management and analysis tools).

Our Commitment is to:

- continue to coordinate across Canada to maximize the technical efficiency of research and cultivar development (e.g., environmental testing sites, big data analysis capacity, 'omics' services).
- share relevant data on wheat genomics with global wheat research communities.

The case for wheat research investment

With increasing world population and a more challenging growing environment, there will be a greater demand for Canadian wheat. Given the tightness in the global wheat markets and the global reach of Canadian wheat exports, production reliability is critical to maintaining Canada's market position and supports efforts to increase global food security.

Climate change and environmental issues have an important impact on world wheat production based on projections of rising temperatures and more variable climatic conditions. Studies suggest that a 1-degree Celsius rise in global temperature would be associated with about a six per cent reduction in world wheat production.[1] Wheat research needs continued investments to increase farm gate profitability and to keep pace with advancements being made in other crops.

Wheat research nurtures innovation and collaboration in both public and private sectors. It drives improvements, resulting in the creation of new wheat cultivars and more effective crop management practices that are widely adopted by farmers.

> "Recognizing Canada as a world leader in sustainable agriculture and agri-food production, the Guelph Statement provides a vision to 2028 to rise to the climate change challenge, to expand new markets and trade while meeting the expectations of consumers, and to feed Canadians and a growing global population."

Continued investment in research will ensure Canada continues to be a competitive producer of wheat and wheat products, and wheat remains a robust option for sustainable cropping systems across the country. Research investment is a critical long-term approach to get meaningful improvements in productivity. New wheat cultivars often take 10 years or more to be developed, but their improvements are cumulative and sustainable over the long term. A recent study on the impact of wheat research investment revealed a return on investment of $33 for every $1 of grower funding invested in wheat breeding, based on yield improvements alone.[2]

More precise wheat management, combined with improved genetics, has the potential to increase yield and decrease the susceptibility of wheat to disease and pest threats, such as fusarium head blight, rusts, and insect pressure. Increased productivity can lead to greater profitability and competitiveness.

Canadian wheat is highly regarded as a quality product in global wheat markets. The nutritional profile and functionality of wheat presents opportunities for value-added processing that can contribute to Canada's economic development goals.

[1] Nature Climate Change. 5, 143–147 (2015).
[2] The Benefits and Costs of Producer and Public Investments: Wheat Varietal R&D in Western Canada 1995 to 2020. Katarzyna Bolek-Callbeck and Richard Gray, University of Saskatchewan (2022)

National Wheat Research Priorities 2023-2028

Theme 2
Crop Environment Interactions

A whole systems approach must be utilized when increasing the acres of disease resistant varieties grown in Canada while mitigating climate change risk. The theme of Crop-Environment Interactions includes:

- Integrated Pest Management, including strategies to manage weeds, insects, and diseases.
- breeding for disease resistance and insect pest resistance and/or tolerance.
- approaches to integrated weed management strategies that integrate cropping system management practices and weed biology/ecology to reduce reliance on any single control measure to manage weeds.
- adapted, stable cultivars with abiotic stress resistance established for relevant regions.
- coordinated and funded pest surveillance programs.

Outcome 1:

Sustainable management of insect pests.

Key Targets:

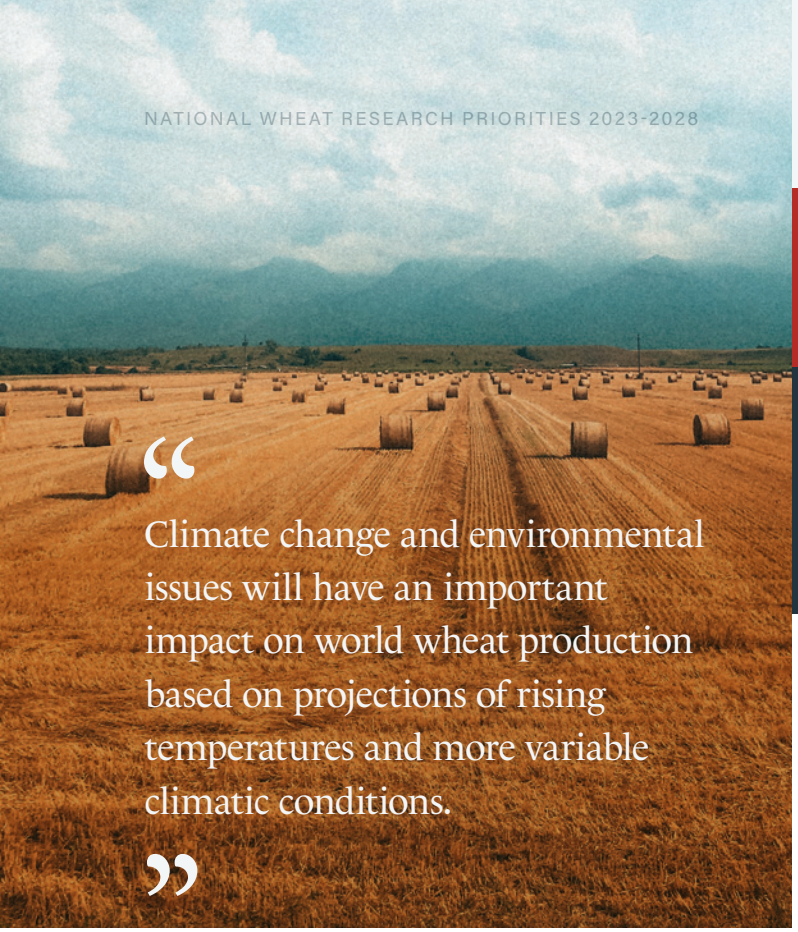
- Develop and improve BMPs (best management practices) for insect management, including but not limited to wheat midge, wheat stem sawfly, cereal leaf beetle, cereal aphids, and wireworm species.
- Discover new genetic sources of insect pest resistance for economically important, emerging, or new threats and incorporate into useful genetic backgrounds readily utilized by cultivar breeding programs.
- Surveillance of key established and emerging insect pests, and for potential pest resistance to crop protection products or genetic tools.
- Develop and implement innovative biological pest control methods including microbes, biofumigants, nematodes, and parasitoids.
- Investigate possibility of reduced efficacy of the Sm1 gene for wheat midge control in CWAD (Canada Western Amber Durum), which impacts crop quality and grading.
- Develop post-registration testing systems and a grading scale for wheat stem sawfly and wheat midge resistance.
- Cultivars are registered to address insect risk (e.g., wheat midge, solid stemmed CWRS (Canada Western Red Spring) for high-risk sawfly region). Monitor varietal blends (susceptible and resistant) to ensure genetics are protected.

Outcome 2:

Sustainable management of wheat diseases.

Key Targets:

- Surveillance of economically important and emerging diseases prior to them becoming significant economic issues.
- Optimize new technologies to improve disease surveillance and management.
- Increase coordination and data sharing across provinces and grower engagement in surveillance efforts (e.g., coordinated access to fields).
- Consider cultivar data to determine interactions with crop genetics and to compare field experiences with registration trial data.
- Develop and improve BMPs for disease management, specifically for fusarium head blight (FHB), leaf rust, powdery mildew, stem rust, stripe rust, leaf spot, bacterial blight and *Xanthomonas*.
- Evaluate and implement prediction models both to inform seasonal management BMPs (e.g., short-term models), and to anticipate the epidemiological spread of disease (e.g., long-term models).
- Identify new sources of disease resistance for economically important, established diseases as well as new or emerging threats, and incorporate into relevant genetic backgrounds readily available to cultivar breeding programs.
- Study the economic impact of the utilization of new resistance sources (e.g., what is the impact of the resistance gene(s) on wheat yield and/or quality). Determine barriers that affect the uptake of resistant cultivars by farmers.



> Climate change and environmental issues will have an important impact on world wheat production based on projections of rising temperatures and more variable climatic conditions.

- Develop new technologies for high-throughput and rapid detection of pathogens and mycotoxins. Harmonize testing methods to reduce variability across regions (e.g., FHB testing).
- Monitor for the development of fungicide resistance in diseases of concern. Fungicide resistance has been most commonly identified globally in leaf spots (e.g., Septoria leaf spot, tan spot) and powdery mildew. There have also been indications that Western Canadian isolates of *F. graminearum* may have varying sensitivity to triazole fungicides.
- Monitor genetic and chemotype shifts in Fusarium populations and the associated mycotoxin profiles.

Outcome 3:

Sustainable management of weeds.

Key Targets:

- Improved BMPs for integrated weed management and to proactively prevent the development of resistant weeds. Solutions must be practical and easy to implement.
- Weed biology/ecology studies for economically important weeds to develop novel management strategies.
- Surveillance to monitor emerging weed issues, including herbicide resistant weeds.
- Pre-harvest weed management research to develop sustainable harvest management solutions, including desiccants.

Outcome 4:

Yield stability under variable climate.

Key Targets:

- Develop G x E x M capacity to integrate the selection of wheat cultivars with relevant agronomic management practices to overcome environmental challenges.
- Standardize protocols for G x E testing for abiotic stresses.
- Identify sources of genetic diversity for abiotic stress, including drought, heat, flood, and freezing/cold tolerance. This could include data analytics to determine G x E interactions from historical data. Introduce new resistance traits into breeding programs.
- Develop new BMPs to mitigate abiotic and biotic stresses, including practices that improve soil health and improve crop resilience (e.g., winter wheat survival during freeze/thaw cycles).
- Determine how biotic and abiotic stresses contribute to the yield gap. Explore the economic impacts of managing factors to close the yield gap.

Our Commitment is to:

- develop and implement tools for BMPs. BMP guides are an important tool for growers, particularly as climate change brings more volatile and unpredictable weather patterns. BMP guides must be living documents that are continuously updated with relevant and timely best practices.
- coordinate with stakeholders and grower organizations to ensure information provided to growers is reliable and consistent across all platforms. Involve wheat commissions and provincial government staff in the creation of communication materials highlighting BMPs.
- create a larger wheat production guide, in addition to factsheets for each BMP (weed, insect, and disease control). This guide should include BMPs for weeds, insects, and diseases as well production tips for yield stability and general crop production info (e.g., seeding date, depth, rate, timing of swathing and harvest).

National Wheat Research Priorities 2023-2028

Theme 3
Cropping System Sustainability

Growers understand the importance of crop rotation as part of their best management practices and their role in sustainable Canadian agriculture. This theme demonstrates the role wheat plays in sustainable crop rotations, and focuses on maximizing the contributions of inputs to crop yield and quality while reducing off-target input losses and associated economic and environmental consequences. This theme also includes identifying precision tools and technologies that provide a positive return on investment.

Outcome 1:

Maximize efficiency of input use.

Key Targets:

- Develop system approaches to better measure input use efficiency in the field.
- Improvements made in nutrient-use efficiency, including optimization of products and timing by soil type and other static and dynamic factors.
- Nutrient uptake and utilization studies on wheat to determine best practices for nutrient management (e.g., understanding nitrogen uptake within the plant throughout the growing season).
- Identify systems that demonstrate ≥ 60% Input Use Efficiency.

Outcome 2:

Improved decision-making tools for the farm that benefit wheat crop sustainability.

Key Targets:

- Quantify the uptake of precision management tools through collaborations (e.g., cooperation between AAFC, universities and colleges, grower organizations, the private sector, and international partners).
- Develop and assess decision-making tools and equipment, including precision management tools, to assist growers in maximizing the efficient use of inputs with minimal environmental impact.

Outcome 3:

Increase the sustainability of wheat production systems.

Key Targets:

- Mid-to-long term crop production systems trials to assess the role of wheat in cropping system sustainability, by considering impacts on factors such as soil health, carbon sequestration, integrated pest management, nutrient utilization, crop rotation, cover crops, and tillage.
- All new crop rotational studies include an economic analysis.
- Agronomic trials coordinated and linked to answer new cropping systems questions across broad regions.
- Develop practical agronomic BMPs to increase yield and crop use efficiency achieved for all wheat types, including food and feed where regionally relevant.

> “Investments in research and innovations in agronomy have supported increased yields for Canadian spring wheat, increasing the productivity and resiliency.”

Our Commitment is to:

- increase knowledge transfer activities highlighting the economic and ecological benefits of wheat.
- investments in research and innovations in agronomy have supported increased yields for Canadian spring wheat, increasing productivity and resiliency.
- increase grower access to research results that are relevant to them, starting with the initiation of studies with collective priorities and following through to the dissemination of the research findings. Research projects must be designed for realistic, field-scale application.
- ensure agronomy messaging for Certified Crop Advisors (CCAs) and other advisors is regionally relevant and targeted at advisors and growers in both content and delivery method.

Interaction of G x E x M

G x E x M refers to the interactions of Genetics x Environment x Management. For example, environment may have the largest impact on yield during a year with low rainfall and above average temperatures, so management would represent the yield gap a grower can address. Wheat growers can use their tools to make decisions on fertility and pest management to best utilize their variety genetics and maximize yield potential.

Plant breeding, weed, disease, and insect management, soil, and water all impact yield. Taking an integrated approach to these connections and understanding the impact of each component helps researchers, plant breeders, and wheat growers be better prepared to narrow the yield gap between yield potential and what is actually achieved on the farm.

The G x E x M framework is reflected in Cereals Canada and Agriculture and Agri-Food Canada's Wheat Research Priorities, with themes on wheat yield, wheat yield reliability and cropping system sustainability.

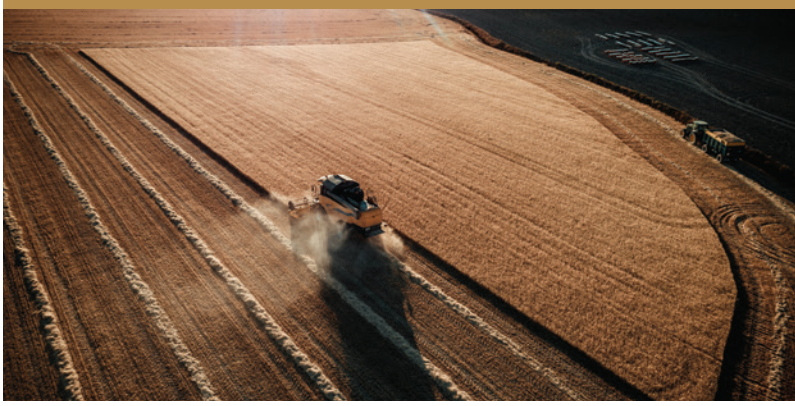
Aligning Priorities

The Next Policy Framework is a five-year (2023–2028) investment by federal, provincial, and territorial governments to strengthen and grow Canada's agriculture and agri-food sector and realize the priorities articulated in the Guelph Statement.

The priorities are:

1. **Climate change and environment**
2. **Science, research, and innovation**
3. **Market development and trade**
4. **Building sector capacity**
5. **Growth and competitiveness**
6. **Resiliency and public trust**

These focused areas are closely aligned with National Wheat Research Priorities.



National Wheat Research Priorities 2023-2028

Theme 4
Continuous Improvement in Food Safety

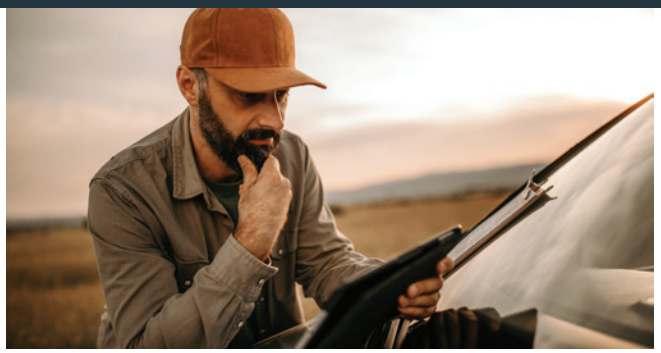
Food safety starts on the farm. Use best management practices (BMPs) to manage food safety risks, which may include:

- pests
- toxins
- heavy metals

The continued development of genetic and other novel resources can be an additional BMP to help manage food safety risks.

The management of known and emerging risks is important in keeping Canadian grains export ready. These practices are consistent with Canada Grains Council Market Acceptance of Pesticide Use Policy.

> "Wheat is an important crop for Canadian farmers but needs continued investments in research to increase farm gate profitability and to keep pace with advancements being made in other crops."



Outcome 1:

Continue to manage risk related to the prevalence of pests and other food safety pressures, including but not limited to mycotoxins, heavy metals, microbes, and pesticide residues, in Canadian wheat to meet compliance with varying global regulations and standards.

Key Targets:

- Develop genetic solutions, agronomic BMPs and processing solutions to manage food safety risks, including mycotoxins, pesticide residues, heavy metals (e.g., cadmium and others) and emerging issues (e.g., acrylamide, bacterial contamination (e.g., *E. coli*), and ergot alkaloids).
- Work with the value chain to establish/strengthen BMP communication campaigns targeted at growers and market access opportunities. Determine barriers to adoption of BMPs.
- When considering food safety research, include the spectrum of activities—from genomics and breeding for disease resistance to grain storage and handling to food and feed processing.
- Continue to monitor heavy metals levels during the cultivar registration process and in grain so that breeders and other researchers have clear benchmarks.
- Establish interdisciplinary research efforts to better understand heavy metal accumulation in crops and the impact of management interventions for a range of heavy metals.

Outcome 2:

The Canadian food safety system proactively identifies and manages new and emerging food safety issues.

Key Targets:

- Establish coordinated, formal data sharing networks to understand, assess, and prioritize potential risks (e.g., background levels of heavy metal and microbial pathogens) and emerging risks (e.g., free asparagine content and microplastics).
- Develop and implement models to assess the impact of interventions on downstream risk (e.g., the impacts of management interventions are often assessed on field samples, but we need a collaborative approach to see the impact of interventions on harvest and export samples).
- Assess the feasibility of a coordinated public-private Canadian food safety system to share data and proactively respond to food safety issues.

Our Commitment is to:

- explore the development of a coordinated and collaborative Canadian system to proactively monitor and communicate global regulatory changes and food safety challenges, for known and emerging food safety risks.
- improve knowledge transfer of BMPs to the entire value chain to reduce potential hazards, including mycotoxins, microbial risks, heavy metal accumulation and pesticide residues.
- incorporate current global (CODEX) standards for heavy metals into the Prairie Recommending Committee for Wheat, Rye, and Triticale (PRCWRT) and Quality Evaluation Team (QET) assessments to continue to keep breeders aware of global targets, including regulations in key markets that may be more stringent than Codex standards.
- disseminate information on global regulatory changes and food safety challenges to the value chain in a regular, coordinated process. As the speed of regulatory change increases, it is important for the value chain to have updated information. Those at the forefront of trade have insight into emerging issues and potential remediating measures from several perspectives.
- gather and share feedback from processors and end-users to help breeders and developers set targets, to help agronomists and growers implement BMPs, to help researchers and monitoring programs ensure they are evaluating relevant risks, and to help exporters assess and respond to market risk. Cereals Canada efforts to gather and communicate end-user feedback to the value chain is an example of how information about food safety and regulatory updates could be gathered and communicated to the value chain.
- assess and prioritize food safety risks relevant to Canadian wheat to help ensure that energy and resources are efficiently used.

National Wheat Research Priorities 2023-2028

Theme 5
Customer Quality

Canadian wheat buyers expect consistent, reliable quality when it comes to purchasing Canadian wheat for their end products. Cereals Canada works with the value chain to engage and communicate information on market requirements, trends, and opportunities for all classes to international and domestic customers.

> "National research priorities provide a vision and targets for the industry while still recognizing the importance of regional priorities."

Outcome 1:

Market opportunities for Canadian wheat are increased.

Key Targets:

- Continue to capture and communicate customer feedback to the value chain and researchers.
- Gather information on international wheat quality, movement and blending data from a variety of sources, including Cereals Canada, Canada Grains Council, International Grains Council, the value chain, and commercial sources to benchmark Canadian wheat industry performance.
- Monitor new and emerging market opportunities for Canadian wheat through exporter and end-user interviews.
- Monitor demand for Canadian wheat yearly and assess demand versus competitors.

Outcome 2:

Align breeding and research efforts, including agronomy, with the needs of grain companies, millers, and customers to meet the demand for sustainably produced wheat.

Key Targets:

- Provide clear signals to breeders and variety developers related to wheat quality needs annually so they can adjust their breeding objectives (e.g., should they maintain the quality of certain classes and improve other ones, etc.)
- Assess the impact of reduced inputs on the quality of Canadian wheat, including protein quality and quantity, and other processing attributes.
- Gather and communicate end-user quality experiences to the wheat value chain including researchers and breeders. This could include quality attributes for food processing, as well as phytosanitary requirements to maintain market access.
- Quality information updated for wheat classes and variety registration.
- Develop rapid, cost-effective quality tests for screening quality (e.g., gluten strength, enzymes, and milling properties) in early generation lines and at point of delivery.
- Develop molecular markers for wheat quality attributes, including milling properties, enzymes, and gluten strength.
- Develop production models and agronomic BMPs to maximize the quality and consistency of wheat production in relevant classes.

Our Commitment is to:

- continue to capture and communicate customer feedback on grain quality to the value chain.
- widely disseminate updates of end-user quality needs to the value chain.
- increase the communication of wheat class attributes, particularly new classes, throughout the value chain, from breeders through to growers and end-users.
- monitor wheat cultivar quality attributes prior to and throughout commercialization, and examine the impact on end-user experiences. Develop mechanisms to use this information to guide variety marketing and saturation.

Wheat is an important crop for Canada's food security, economic development, and sustainability goals

The success of wheat production in Canada will increasingly depend upon the recognition that wheat contributes to food security at home and abroad. Canadian wheat is a leading agri-food export crop and fills a unique sustainability gap in crop rotations, by providing a cereal crop option with environmental benefits such as improved soil health and reduced pest pressure. The value of wheat in these complex areas of the food system underlies its importance in meeting Canada's stated goals for the agri-food sector.

Food Security: Wheat is a staple food for 35% of the world's population and provides more calories (averaging 20% for calories and protein) than any other crop[1]. Canada was the world's sixth largest producer of wheat on average between 2000-2020[2] and one of the top 3 exporters of wheat.

Wheat is also a nutritious component of Canadian diets through both refined and whole grain wheat and wheat products. In Canada, it is mandatory to fortify refined flour (i.e., all-purpose) with iron, folic acid, thiamine, riboflavin, and niacin. Whole wheat and whole grain wheat flour are important sources of many nutrients including dietary fibre and magnesium. In spring 2022, the Canadian government urged Canadian producers to grow more grains such as wheat in response to global food insecurity.

Economic Development: As the second most traded crop globally (next to maize), Canada will need to continue to research and innovate to remain competitive with wheat from other regions and help meet Canada's agri-food export goal of $85 billion by 2025[3]. Canadian wheat is divided into classes based on protein level and functionality. Canada has some of the highest quality wheat in the world with guaranteed high protein levels. Canada must ensure that the variety classification system is meeting the needs of the value chain, including producers, grain handlers, customers, and end users, by providing fit-for-purpose protein functionality and a reliable supply of relevant classes. Plant breeders need clear signals from the variety classification system in order to make efficient progress in variety development.

Sustainability: Wheat plays an important role in sustainable crop rotations across Canada by reducing pest pressure and contributing to soil health. Wheat is less sensitive to yield reduction in dry years than oilseeds and corn and can promote resiliency in cropping systems. To achieve sustainability goals for wheat in crop rotations, wheat must still be an economically profitable, high-yielding choice for growers. Research and innovation will also be essential to meet Canada's nitrogen fertilizer emission reduction targets (30% reduction by 2030). Nitrogen is a building block of protein and reducing nitrogen fertilizer inputs can potentially impact protein levels and yield in wheat crops. Maintaining quality wheat with the appropriate protein functionality to meet end-user needs will keep Canadian wheat competitive in global markets.

Research funding programs must recognize the complexity and interconnectedness of wheat's role in meeting Canada's goals. Sustainability and economic development goals must be considered when pursuing research projects. The research funding system must not only accommodate but promote cross-over between objectives and the assessment of research impacts through multiple lens.

[1] International Development Research Centre (IDRC) Communications (2010) Facts and Figures on Food and Biodiversity
[2] FAOSTAT https://www.fao.org/faostat/en/#data
[3] Report of Canada's Economic Strategy Tables: Agri-food (2018) The Innovation and Competitiveness Imperative: Seizing Opportunities for Growth.

National Wheat Research Priorities 2023-2028

Theme 6
Wheat Nutrition

Wheat is a staple food ingredient across the world and plays an important role in health, nutrition, and food security. With wheat being versatile, identifying novel opportunities for wheat products to sustainably deliver nutritional benefits to a growing population is critical.

In creating this new theme for 2023, the Wheat Nutrition working group set the following goals:

- to continue to identify the role of wheat and wheat products in aspects of nutrition and health, and their importance in food security;
- to synthesize evidence on the importance of wheat and wheat products in nutrition and health;
- to identify novel opportunities for wheat products to sustainably deliver nutritional benefits to a growing population; and
- to identify ways wheat products and ingredients can provide enhanced nutrition with lower environmental impacts.

Outcome 1:

Canadian wheat and wheat products are recognized as nutritious components of healthy diets, contributing to food security, nutritional health, and sustainability.

Key Targets:

- Assess bioavailability of nutrients, including minor components, and nutritional profiles of enriched refined and whole-grain wheat products and determine their role in balanced diets
- Model the important role of wheat in Canadians' diet across different population groups.
- Determine the public perception of wheat and wheat products in nutrition, including the role of wheat in food security and sustainable diets.
- Determine the impacts of grain-free and low grain consumption trends on the burden of disease for populations as well as impacts on food security
- Investigate potential antinutritional factors in wheat.
- Investigation of impacts of climate change and environmental sustainability practices on the nutritional value of Canadian wheat, for example, the impact of reduced crop inputs on nutritional quality, availability, and affordability.
- Expand nutrigenetics and nutrigenomics research to identify individual needs for optimal nutrition and individual tolerances related to various wheat components, resulting in recommendations for personalized nutrition counselling.
- Determine the role of wheat in health outcomes, which could include metabolic health, digestive and microbiome health, immunity, mood, sleep, cognition, and brain health.

Outcome 2:

Wheat production and processing provides enhanced nutrition and value-added products for Canadian and global markets.

Key Targets:

- Test variety development and/or food science solutions to enhance nutritional properties of wheat products and enable utilization of high-nutrition varieties (e.g., high amylose wheat varieties, fortification, processing methods to increase resistant starch, high fibre, nutrient bioavailability).

- Develop processing methods that provide stable wheat products with value-added nutrition (e.g., omega fatty acids, folate, fibre).
- Support development and marketing of value-added Canadian food products, drawing on Canada's production strengths, to increase the nutritional value of frequently consumed foods and achieve lower environmental impacts (e.g., blending wheat ingredients and fractions with other sources of plant-based proteins to improve the quality of plant-based products).

Our Commitment is to:

- disseminate wheat nutrition research results through the "What About Wheat?" platform for consumers and dietitians.
- communicate customer and consumer feedback on grain quality and nutrition to the value chain, researchers, and growers.

> "Wheat is a staple food for 35% of the world's population and provides more calories (averaging 20% for calories and protein) than any other crop."

- increase communication between wheat nutrition researchers, plant breeders and wheat processors and end users.
- provide a forum for the participation of nutrition researchers in wheat variety registration meetings to increase value chain awareness of the latest development in nutrition research.

Committee Members

Cereals Canada would like to thank past and present working group and committee members for their contributions to the National Wheat Research Priorities. The working group members included here contributed to the most recent update and are listed with the organization they were with at the time they were active on the project.

Research Priority Co-Chairs

Dr. Felicitas Katepa-Mupondwa
Agriculture and Agri-Food Canada

Krista Zuzak
Cereals Canada

Theme 1
Improving Wheat Yield

Dr. Andrew Burt, Co-Chair
Agriculture and Agri-Food Canada

Dr. Santosh Kumar, Co-Chair
Agriculture and Agri-Food Canada

Dr. Robert Graf
Agriculture and Agri-Food Canada

Dr. Richard Cuthbert
Agriculture and Agri-Food Canada

Dr. Silvia Barcellos-Rosa
Centre de Recherche sur les Grains

Dr. Josh Cowan
Grain Farmers of Ontario

Dr. Shawn Gibson
Government of Saskatchewan

Dr. Barbara Ziesman
Government of Saskatchewan

Blair Goldade
Saskatchewan Wheat Development Commission

Dr. Curtis Pozniak
University of Saskatchewan

Theme 2
Crop Environment Interactions

Dr. Aaron Mills, Co-Chair
Agriculture and Agri-Food Canada

Dr. Tyler Wist, Co-Chair
Agriculture and Agri-Food Canada

Dr. Maria Antonia Henriquez
Agriculture and Agri-Food Canada

Cosmin Badea
Canterra Seeds

Dr. Silvia Barcellos-Rosa
Centre de Recherche sur les Grains

Dr. Brian Beres
Agriculture and Agri-Food Canada

Dr. Brent McCallum
Agriculture and Agri-Food Canada

Dr. Michel McElroy
Centre de Recherche sur les Grains

Dr. Adam Foster
Agriculture and Agri-Food Canada

Patti Rothenburger
Manitoba Agriculture

Anne Kirk
Manitoba Agriculture

Theme 3
Cropping System Sustainability

Dr. Josh Cowan, Co-chair
Grain Farmers of Ontario

Josh Boersen
Grain Farmers of Ontario

Carmen Prang
Saskatchewan Wheat Development Commission

Lori-Ann Kaminski
Manitoba Crop Alliance

Jake Leguee
Grower

Salah Zoghlami
Producteurs de grains du Quebec

Michael Delaney
Government of Prince Edward Island

Theme 4
Continuous Improvement in Food Safety

Dr. Ron DePauw, Co-Chair
Secan

Lynne Sweeney, Co-Chair
Richardson International

Sheilagh Arney
ADM

Meili Hao
ADM

Gino Castonguay
Canadian Grain Commission

Richard Kieper
Paterson Grain

Dr. Martin Scanlon
University of Manitoba

Dr. Sheryl Tittlemier
Canadian Grain Commission

Dr. Sean Walkowiak
Canadian Grain Commission

Salah Zoghlami
Producteurs de grains du Québec

Dr. Claudia Narvaez
University of Manitoba

Dr. Yuefeng Ruan
Agriculture and Agri-Food Canada

Susan Abel
Representing Canadian National Millers Association (Consultant)

Theme 5
Customer Quality

Ellen Sparry, Co-chair
C & M Seeds

Dr. Harpinder Randhawa, Co-chair
Agriculture and Agri-Food Canada

Cosmin Badea
Canterra Seeds

Adam Dyck
Warburtons

Dr. Ron DePauw
Secan

Dr. Constance Chiremba
Saskatchewan Wheat Development Commission

Lori-Ann Kaminski
Manitoba Crop Alliance

Richard Keiper
Paterson Grain

Lindsay Bourré
Cereals Canada

Lorena Pahl
BASF

Patti Rothenburger
Manitoba Agriculture

Dr. Martin Scanlon
University of Manitoba

Elaine Sopiwnyk
Cereals Canada

Dr. Richard Cuthbert
Agriculture and Agri-Food Canada

Trent Rude
Viterra

Peter Entz
Richardson International

Sheilagh Arney
ADM

Meili Hao
ADM

Valerie Durand
Grupo Bimbo

Dr. Robert Graf
Agriculture and Agri-Food Canada

Connie Briggs
University of Saskatchewan

Dr. Pierre Hucl
University of Saskatchewan

Dr. Curtis Pozniak
University of Saskatchewan

Paolo Santangelo
SGS Labs

Dr. Jaswinder Singh
McGill University

Dr. Silvia Barcellos-Rosa
Centre de Recherche sur les Grains

Dr. Bin Xiao Fu
Canadian Grain Commission

Theme 6
Wheat Nutrition

Dr. Hassan Vatanparast, Chair
University of Saskatchewan

Dr. Sijo Joseph
Agriculture and Agri-Food Canada

Dr. Rebecca Mollard
University of Manitoba

Dr. Elsayed Abdelaal
Agriculture and Agri-Food Canada

Dr. Michael Gaenzle
University of Alberta

Dr. Julie Jones
St. Catherine's University

Dr. Harvey Anderson
University of Toronto

Dr. Maneka Malalgoda
University of Manitoba

Dr. Mehri Hadinezhad
Agriculture and Agri-Food Canada

Thank you to Synthesis Agri-Food Network for its work on the National Wheat Research Priorities and for facilitating the committee members and working groups.

CEREALS CANADA

1000-303 Main Street
Winnipeg, Manitoba R3C 3G7
Canada

Phone: 204-942-2166
Toll Free: 1-833-956-2444

cerealscanada.ca

In partnership with

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada